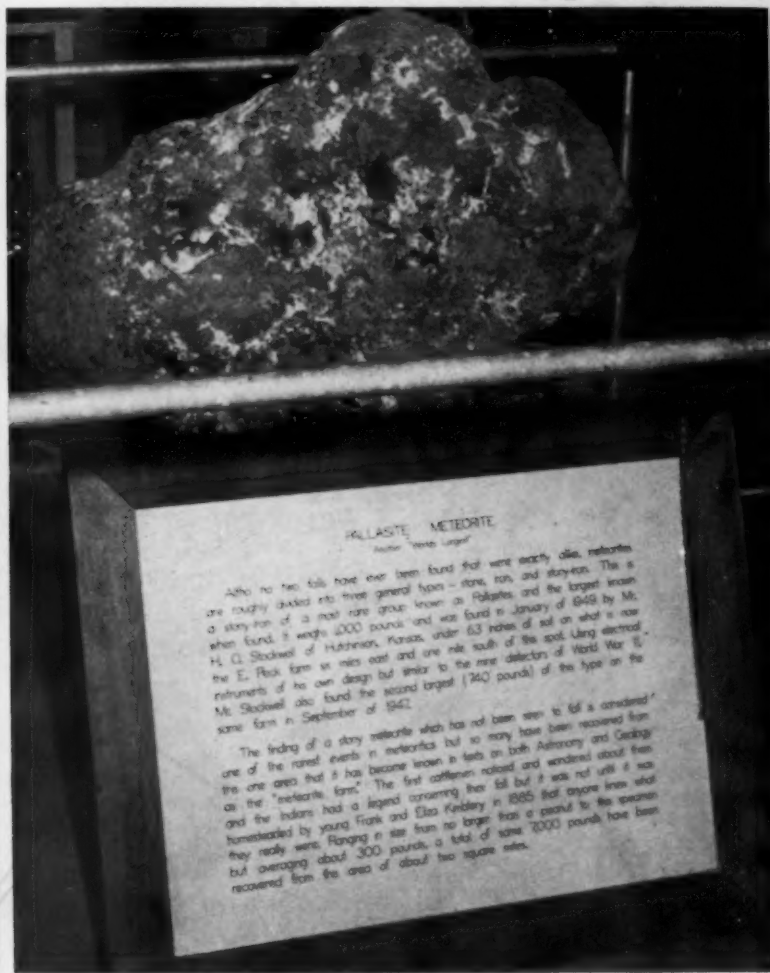


# Earth Science

## Rockhounds' NATIONAL Magazine



Largest Pallasite Meteorite. (See page 19.)

35¢

January-February, 1956

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This is sort of a "dividend" on the story of the "Great Hand-Dug Well" that was so much enjoyed in our last issue, for it describes a pallasite meteorite weighing 1,000 pounds that was found east of Greensburg, Kansas, and is on exhibit at the Celestial Museum at the Well in Greensburg. Cover illustration.		
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## EDITOR'S MEMO PAD

"A thing of beauty is a joy forever; Its loveliness increases; it will never pass into nothingness."

—Keats

Keats was a poet who never even dreamed of the present atomic age, or else perhaps he might well have qualified his last statement.

In event of atomic warfare—what a horrifying thought, but we may as well face facts and possibilities—then what goes on? In case the "dam'd human race" (quoting Mark Twain) survives, and what is left of it eventually pulls itself together again, and starts picking up the snarled loose ends of the so-called modern civilization we now know, what a sorry picture will be presented.

In addition to the hundreds of millions of precious lives that will be lost, and the great cities, the pride of our country, which will be utterly destroyed, let us think also of the many fine art galleries, museums and libraries, now filled with multitudes of irreplaceable art treasures, and priceless materials of all kinds, which will be no more.

Throughout previous history, when former civilizations have faded and fallen into decay, their passing was more often a process of slow disintegration, and much of their art and other treasures became only temporarily lost, buried possibly for ages in the rubble of destroyed temples, only to be dug up again, perhaps, and restored to view, by the spade of modern archaeologists. Not so will be the fate of our great cities of today, which might even be completely evaporated and thus totally erased from the face of the earth forever, never to be restored again.

Keeping in mind only our own great field of interest—geology and mineralogy, most certainly the great collections of the National Museum at Washington, the Metropolitan Museum of New York, and the Natural History Museum of Chicago would be no more, to say nothing of many other notable collections located elsewhere throughout the world.

We have now arrived at the crux of our thinking along this line. Too much cannot be said in favor of our present day collecting hobby, and the vast wealth of superb mineral material which is constantly being added to the personal collections of these ardent hobbyists, called our amateur mineralogists. These collections may now

be numbered by the tens of thousands, and by and large, in all probability the sum total of all this collected material may be of greater proportions, and of as favorable a quality, as the combined collections of our present great museums, which are now the pride of the nation.

We need not further belabor the point. Much of this material, scattered widely in many out of the way places throughout the country, would seldom if ever be ravished by atomic warfare, and thus would then eventually become the nucleus of other great collections, again to be gathered together for the benefit and pleasure of future, and we hope wiser, generations of museum lovers to come. This we strongly feel is a matter which should always be kept in mind, and is something to be pondered over seriously by every collector in our midst today. Believe us, amateur mineralogists are important people, and their collections, be they large or small, are very much worthwhile.

### *Georgia Mineral News Letter*

We believe that nothing comes to our desk that compares with the *Georgia Mineral News Letter*, published quarterly by the Georgia Geological Survey, 425 State Capital, Atlanta, "for the benefit of Georgia mineral producers, the Georgia Mineral Society, and the Earth Science groups."

It is a superb publication in a class all by itself, and might well be ranked in the mineral world with the *Arizona Highways* in its field, which is decidedly tops. What it is difficult for us to understand is why more of the State Geological Surveys can't wake up and start something of a like nature for the Earth Science interests in their states, which they should remember are also a part of the tax-paying constituency which supports them so, more or less, liberally.

A little more of the educational interest, it seems, from the "top down," would certainly be a very wholesome and welcome innovation.

### *"There's Gold in Them Thar Hills!"*

Acting upon an impulse fathered by a suggestion in the March-April, 1955, *EARTH SCIENCE*, after reading the article on "Panning Gold in Georgia," Elmer Wilhelm and party of the Mineralogist Society of Joliet, headed for Dahlonga, as a side trip on their way down to Florida.

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They were very well pleased with the courteous reception given them by the "native" residents of the vicinity, and among other things, after about four hours of "panning," they were able to return with a "bragging" bottle, with a nice showing of gold dust from the place were gold was first discovered in the United States.

This proved to their own satisfaction that there is actually "Gold in Them Thar Hills," and they also learned this was the place where this very famous expression first originated, way back in the early nineteenth century. Elmer says that this was a worthwhile experience, and that he would advise others traveling down to Florida on U. S. Highway 19, to drop by and try it for themselves, as something to be remembered.

#### Authors

LLOYD H. SPRINKLE, of Livonia, Michigan, is both a distinguished scholar in the field of optics and a master practitioner of the optician's art. It is a real privilege to publish his paper given at the Midwest convention at Detroit . . . JOHN F. MIHELICIC, of Detroit, is one of the best known amateur mineralogists in the country. He currently is mineralogy division chairman of the Midwest Federation, of which he is a past president . . . EDITH A. (MRS. SAMUEL E.) KIRBY, of Riverside, California, has given hundreds of talks and demonstrations on mineralogy to children in the local schools. Mr. and Mrs. Kirby exhibited a fine collection of polished spheres at the Detroit convention . . . DR. W. B. S. THOMAS, of Lyons, New York, will be favorably remembered for his "Geological Fairy Story" in our last September-October issue . . . ARTHUR ANDERSON insists that all of his companions in the trip to Michipicoten Island, besides being fellow members of the Minnesota Mineral Club, were collaborators in writing the account of the trip. DR. L. O. DART, Minneapolis physician, is a world-traveler, who perhaps has pursued the rockhound hobby as widely as anyone.

GEM CUTTING, A LAPIDARY'S MANUAL, by John Sinkankas. Van Nostrand, 413 pp., \$8.95.

Commander Sinkankas has given concrete evidence of his high ability as a lapidary by the gem stones of his own cutting which he has exhibited at mineralogical conventions, especially in the East. It could be expected, then, that in a book on gem cutting he would have much to report from his own experience at the wheel and lap, and from his restless interest in new gem materials.

Consequently, it is no surprise that his two chapters on faceting, his specialty, are excellent, and that the chapter on cabochon cutting is almost as good. So is a chapter on short cuts, hand methods, and shop hints. Most of Sinkankas' methods are conventional, such as his reliance on the mechanical faceting rig, and even at times old fashioned, as in his liking for loose grit as an abrasive, but he has many common sense observations of value even to an equally experienced lapidary.

The chapters on equipment, sawing, grinding, sanding and polishing are rather overdetailed with information easily available elsewhere. The chapter on geology for the gem prospector is

dull, but it introduces a section discussing individual gem materials which has some excellent qualities. For one, Sinkankas gives his own experience with rough from many places and makes invaluable recommendations and comments on availability of particular materials, although he is occasionally led into error, such as listing agates from the Fox River of Illinois, a "ghost" location. On the other hand, he has cluttered up a very useful list with many materials so rare or so difficult to cut, or so unattractive after they are cut, that they would interest few lapidaries.

It is odd, too, that he makes no mention of synthetic materials, such as titania (rutile), or corundum or spinel.

An extensive apparatus of tables closes the book. One on current prices of gem rough is of value, but the lists of mineral societies, public collections, state geological offices, and dealers and manufacturers are somewhat ephemeral for a reference book, and are easily available in magazine or handbook form.

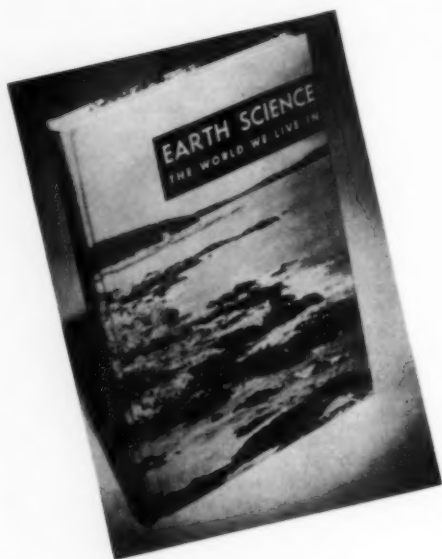
The book is well manufactured, with one color plate and a number of text illustrations, of which the how-to-do-it drawings are the most useful.

It is unfortunate that in title and in physical appearance the book resembles several standard lapidary texts. The most obvious resemblance is in the duplication of the title of Dr. J. Daniel Willems' book, "Gem Cutting," which has some years of prior claim to the title. Commander Sinkankas, it is understood, reported that the title was chosen by the publisher without consultation with him. — MACFALL.

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#### ***"Rockhounds" delight in thumbing through . . .***

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# Earth Science

JANUARY-FEBRUARY, 1956

Vol. 9, No. 1

## Below the North Rim

by RUTH A. KIRKBY

WE INSCRIBED OUR NAMES on the sheet of paper in the rustic register box: Mr. and Mrs. Sam Kirkby and son, Noel; destination, Phantom Ranch; return route via North Rim, Grand Canyon.

With this simple ritual we began our descent into one of the most colorful and geologically interesting earth cracks located in the United States. Although thousands of tourists visit the Grand Canyon every year, relatively few descend below the rim either by mule or on foot.

We left Bright Angel Point early this July morning and hiked along a wide and gradual trail with tall trees of fir and pine framing a magic view of Bright Angel Canyon. The distant San Francisco peaks looked like tiny piles of sand on the flatness of the Colorado Plateau to the south.

During the first 4½ miles we descended 3,800 feet and the trail changed from a wide forested path to a narrow series of switchbacks cut in the red Hermit Shale. Wildflowers were rooted in rock cracks beside the trail and lizards watched us curiously as they sunned themselves on the rocks. The canyon seemed to deepen more rapidly and the walls rose in sheer vertical lines above us. We leaned heavily mountainward and although the view was a constant scene of changing beauty, our gaze was glued to the narrow ledges over which we were traveling to the exclusion of all other sights.

The sound of rushing water was strong in our ears when we arrived at beautiful Roaring Springs, rightly named, as the spring waters rush out from under the great ledge of Redwall Limestone and converge many feet below into Bright Angel Creek.

The next mile of our trip brought us to

the power house, where the water and power for the North Rim are developed. Mr. and Mrs. Hurman Ruesch and their son and daughter greeted us from the porch of the caretakers' house. While visiting with these gracious people, we ate our lunch and made arrangements to leave with them our supplies for lunch the next day.

After lunch, we crossed the narrow swinging bridge over Bright Angel Creek and began to hike along a trail so dusty that we sank in several inches with each step. We were to descend 1,500 feet in the next 9½ miles, but we began a circuitous trip up and down, over and around many small hills to achieve this drop in elevation. The mountains were tremendous and we felt very humble among these giant temples. The vermilion colored Grand Canyon Series seemed to be shooting their tilted layers up into the Cambrian overburden. This one jagged line of erosion spanned an uncertain number of years at the end of the Proterozoic Era.

The loose red shale scattered along the trail was spotted with sage green, suggesting that the overworked Park Rangers had dribbled paint, when they decorated this masterpiece of a canyon.

The afternoon heat of this July day became oppressive and although the rushing waters of Bright Angel Creek could be heard gurgling close by, it was often difficult to get to the water for long distances from the trail running high above on the rock walls of the canyon. We anticipated the stream crossings and gladly pulled off our shoes and socks to wade in the cool water.

We were entering the narrowest part of Bright Angel Box Canyon and the walls

seemed to be closing in around us. As we gazed straight heavenward past dark Pre-Cambrian rocks, capped with the blue of an Arizona sky, now and then a fluffy white cloud sailed by. The trail was actually carved from the dark rock walls of the canyon at this point and the rocks served to radiate the heat until it was uncomfortable to stop for rest periods. So we continued hiking, hoping for more frequent stream crossings. Our tongues began to swell and our throats were parched, while the stream crossings seemed farther and farther apart. Suddenly we saw a few mules at a hitching post and then a ranch house of natural wood. This was Phantom Ranch, like an oasis after the extreme heat of the box canyon.

We checked with the attendant regarding our reservations and were shown our cabin across the clearing. A quick dip in the swimming pool restored our energies and we had time to dress just as the dinner bell rang.

Our dinner was well prepared, good food but the tall glasses of iced tea made the biggest hit. Looking around the long table in the rustic dining room, it was apparent which of the guests had arrived by mule back as they sat gingerly and were wary of their raw spots, while we hikers sat wearily, glad to rest our tired feet.

We still had a short hike down to the Colorado River and, when we learned that one of the rangers had been riding trail all day, we persuaded him to walk with us and get a little exercise. We scurried through the mule corral at feeding time, on past the wranglers' cabin, then past a camp ground, along a level trail close to Bright Angel Creek as it begins its entry into that "too thick to drink, too thin to plow" muddy Colorado River. After a few feet, the clear sparkling waters of Bright Angel Creek are blended in with the silt ridden load that this great river carries every day on its way to the lake now in back of Hoover Dam.

Kaibab suspension bridge crosses at this point of our trip; the 440-foot span of bridge is just wide enough for the mules and their riders to cross in single file. When you stand in the middle of this span of

cables and look at the mighty Colorado, you sway a bit and then the river seems to flow in small whirlpools, tossing bits of debris and rock around and around. The south side of the canyon seems to rise abruptly from the water's edge and great piles of talus scallop the south bank.

The majestic mountain tops still shone in the sunlight, but shadows were making patterns around us in the inner gorge of Grand Canyon. Back at Phantom Ranch, we were glad to join the other guests in a nice cool swim and get-acquainted visit.

After awhile the guests began to drift along to their cabins with every intention of getting a good night's rest. It was then that Mother Nature turned up her thermostat and a gentle hot wind began to blow through the canyon. We tossed about, for the night hours in the torrid little cabin seemed endless. Deer rubbed against the window frames and Bright Angel Creek rushed by in a frenzy to reach the muddy waters of the Colorado River below.

At the earliest possible moment everyone in camp seemed to arrive at the swimming pool for a nice cool dip before breakfast. The bell rang promptly at 7:00 o'clock to announce breakfast. Goodbyes were hastily said and we hikers, anxious to get through seven or eight miles of the box canyon before the sun made the walls unbearable, set about at a good rapid pace.

The ups and downs of the dusty trail were easily taken in stride for the first four or five miles, then heat and dehydration became a problem. The few scattered clouds, which occasionally covered the sun, were appreciated, as they kept the hikers in shade for a few seconds every now and then. The particularly long stretches of trail between water crossings found the hikers exhausted, thirsty, with tongues swollen, and the canyon walls pressing in until we felt like we were strangling. We thought we would never find more water and still we could hear the stream rushing by below us. One more hill, no water. One more turn, no water. When we decided that we had much further to hike, the next turn gave us a





" 'Buddha Temple,' taken from half way down canyon."



"View of Bright Angel Canyon from Rim This is the canyon we followed down. Note tree root hanging over rim at left, where soil has eroded, leaving root in mid-air."

pleasant surprise and we were so dehydrated that we just dashed to the stream and splashed water over our heads and shirts and jeans in delight.

After this refreshment we tackled a new stretch of trail in the pressing heat of the sun. Our hands were swelling and we lashed our gear to our belts and continued over many little hills and turns, finally arriving at a beautiful waterfall, where we had decided to swim on our return trip. We scrambled through the brush, over several large boulders and, changing into our swim suits, we headed for the icy cold water under the falls. The aerated water falling free from the large boulders overhead splashed into the large pool with great force, then surged along among the rocks of Bright Angel Creek as if it were late for a date with the Colorado.

Reluctantly we climbed over the boulders and through the brush back to the trail. We were just a short distance from the power house now and the lunches that we had waiting for us. We visited with our hosts, the Ruesch family, while eating our lunch and then stretched out on the cool blanket of lawn for a short rest in preparation for the strenuous hike ahead. Ten-year-old Butch Ruesch invited us to have a real good swim in his private pool, and so we walked the flumestock, wandered down a short path and over an immense boulder to discover a real Huck Finn type swimming hole, well screened by trees and vegetation.

Of necessity this was a short swim and we hastened back to the power house to bid our new found friends goodbye. Mrs. Ruesch presented us with 20 beautiful speckled mountain trout frozen in ice. We stowed this fine makings for dinner in our pack and began the ascent of the steep part of our climb. As we found it necessary to walk slowly, we had more time to enjoy the wonderful view. We were walking along the horizontal layers of Cambrian time, fossiliferous limestones of around 500 millions of years ago. Limy oozes and muds were laid down in ancient seas during the Age of Trilobites, leaving fossils for us to study

and ponder about the life that existed at that time.

We puffed and panted as we gradually climbed higher and higher; then we rested and observed the formations of each horizon. We were not disturbed by the tremendous chasm below us, but curious of the formations in which the trail was carved. In places we were inside the earth in a tunnel with the outside opened up, and the great wall above us was merely the continuation of the cliff from which the trail was cut.

The miles seemed to stretch into eternity as we watched for landmarks to chart our progress by. We watched the one great ledge of rock near the top with vertical bands of varnish staining its face. We wanted to call it ribbon rock, as it brought back memories of those beautiful colored hairbows little girls wear. The trail wound on and on and opened up new views at each turn, giant castles, enormous stone walls and pillars eroded away from the mountain side.

The sky had been threatening us for several hours and now a few sprinkles softly dampened our clothing. A few more turns and there was the rustic register box.

As we looked out through the giant pines of the North Rim we felt a closeness with that vast area to the south of us. We had explored the inner fastnesses of this great earth crack. We had seen and touched the layers of earth formed during the first era of time. This experience will keep haunting us until we return to the Grand Canyon.



FIG. 1.

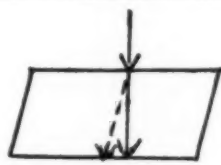


FIG. 2.



FIG. 3.



FIG. 4.

## On the Matter of Seeing Double

by DR. WILLIAM B. THOMAS

THE MATTER OF SEEING DOUBLE may be either optical or illusional, and while the latter may well wear off by about ten a.m. in the morning of the following day, the optical double seeing is real, and a matter of great interest and importance, as we shall presently see.

When the writer was in Rio de Janeiro he went to the Department of Agriculture to look up the head of the mineralogy department. Strange as it may seem, everything in Brazil that comes from the ground is under Agriculture. Finally I located Dr. Pietro Scorza, who was dancing about almost jubilantly, while admiring a cleavage of clear material the size of one's head.

"What is it?" he asked, knowing I would say optical calcite. I was wrong. He picked up a chip, dropped it in dilute hydrochloric acid. It did not effervesce (give off gas). It therefore was not calcite.

"Impossible," I said. "Clear dolomite, perhaps?"

"No, not dolomite," he replied. "Dolomite is clear, looks just like calcite, will not dissolve in dilute acid. But this is not dolomite."

"Well, another member of the group is rhodonite and that is red or reddish brown. So it cannot be rhodonite?"

"No!" exclaimed Pietro. "It is the fourth one of that group, magnesite. In all my life I never saw such a beautiful piece. Look through it. It is optically clear as water and it has double refraction like calcite. You see double."

"I can't believe it. Magnesite cleavages would be wonderful for commercial uses, bomb sights or Nichol prisms. Of course, you have a museum piece."

"Bah!" he exclaimed. "There is more in Minas Geras." With that he picked up a knife, held it on the exact angle of the side,

struck the top of the knife a sharp blow with a hammer. The beautiful piece broke off in a cleavage the size of my fist. He handed it to me as a present.

\*

The meaning of double refraction is explained to a child or a novice in the following manner. A beam of light goes through a pane of glass almost so perfectly that one sees only a single line (see fig. 1) when the glass is placed over it.

With clear optical calcite, dolomite, magnesite or even light red rhodonite the light travels in a straight line; however at right angles to the surface it is also bent to follow the angle of cleavage (see fig. 2), so that one sees instead of one, two parallel crosses as shown (see fig. 3).

Now as the prism is slowly rotated through an angle of  $90^\circ$  these lines appear to separate and then come together again, until the two are the same line once more and appear as only a single line (see fig. 4).

\*

This double refraction is useful in many instruments. If you have a real image and a phantom image separated by a known distance, knowing the speed of a plane and the time an object will take to fall from say 20,000 feet ( $\frac{1}{2}$  gravity, time squared), one can make a bomb sight with crossed spider webs for the crossed lines. Then the release is pulled on the crossing of the phantom lines of the target and the bomb drops in on the target.

Some materials such as dextrose turn a beam of light to the right—hence dextra-right-ose = sugar. Levulose—left turning. You look at a line—it is turned 5 degrees to the right. A Nichol prism or calcite prism cleavage put in the picture to measure that degree of turning will measure the sugar strength of a solution.

◀ See explanation of figures 1, 2, 3, 4 on page 10.



SCULPTURED HEAD OF PRESIDENT EISENHOWER CARVED IN MINIATURE IN GEM QUALITY BLACK STAR SAPPHIRE, FLANKED BY HEADS OF LINCOLN AND WASHINGTON CARVED BY THE SAME ARTIST, HARRY B. DERIAN. (Photo by Alvin Y. Garner, Alexandria, Virginia.)

## Eisenhower Head Sculptured in Sapphire

by DR. BEN HUR WILSON

AMONG THE MANY EVENTS of interest which occurred at the joint convention of the Eastern and American Federations held in Washington, D.C., in September, was the unveiling of the sculptured head of President Dwight D. Eisenhower carved in miniature, in gem quality Black Star Sapphire, by Harry B. Derian, noted artist residing in Southern California.

This occurred at noon, on September 27, in the foyer of the Shoreham Hotel, in the presence of many convention visitors, and the officers of the American and Eastern Federations, who were specially invited guests. The ceremonies consisted of brief talks by the federation presidents, followed by the introduction of the sculptor, Harry Derian, and James Kazanjian, owner, who arranged the formal presentation.

Acceptance was made by the Hon. Charles S. Thomas, Secretary of the Navy, representing the Federal Government, who drew aside the velvet draperies, revealing not only the Eisenhower figure, but also those of Washington and Lincoln, which had been previously sculptured by Derian.

Some six years ago, James and Harry Kazanjian came into possession of five gem quality star sapphires, said to be the largest known to exist. One of these became the famous "Black Star of Queensland," and the others were reserved for the project calling for sculptured heads of great American Presidents. The first, of Lincoln, was completed in 1951, and that of Washington in 1954, and now the third one of Eisenhower joins the other two. The fourth gem will be reserved for the sculptured head of Thomas Jefferson, which has already been started.

The Eisenhower stone was found in Australia about a quarter of a century ago, and is believed to be the largest Black Star Sapphire yet found, its original weight being 2079½ carats. Some 653 carats were carved away in working the stone, there yet remaining 1,444 carats in the sculptured head

at this time. While slight further work was originally planned on the head, work was stopped at the present stage, as minor flaws were discovered in the stone which might have brought about disaster. The present overall dimensions of the carving are 2¼" high, 2 1/16" wide, and 2¼" deep.

The head is mounted on a cube shaped stand of 18 carat gold, and its remarkable asterism is accented by a tiny light bulb at the base shining upward, as shown in the photograph. The entire exhibit remained on display for the remainder of the show, kept closely guarded in a large cube shaped plate glass case. The Eisenhower head has an art value of an estimated \$250,000, and all three works an art value in excess of a half million dollars.

Following the show the exhibit was returned to California by the owners, and it is not yet known where the final permanent reposition will be. If they are ever returned to Washington, either of three places, (1) the Gem Collection in the Natural Museum, (2) the National Art Gallery, or (3) the Library of Congress would be appropriate. This, however, is not a problem for immediate decision, but one to be worked out at some future time.

Something, perhaps, might also be said concerning the truthfulness of the likeness of the President. Credit must be given the sculptor for the sincerity with which he attacked the problem. Before commencing the actual work of carving the stone, a number of small models were made and cast, and technical advice was sought from such distinguished sculptors as Lincoln Borglum, son of the creator of the Rushmore Memorial. As a result, it is agreed by all that the likeness is truly remarkable, and depicts the President, not so much as he appears at the moment, but at the time when he was perhaps at the height of his military career. No one who studies the sculpture carefully could offer serious criticism upon this point.

## A Visit to Michipicoten Island

by ARTHUR ANDERSON

MICHIPICOTEN ISLAND is a fascinating spot for earth science enthusiasts to visit. Whether your interest is in geological formations, mineral deposits, scenery, or just plain rockhound activities, you will find it a delightful place.

The island is located in eastern Lake Superior, near the Ontario shore. It is about seventeen miles long and six miles across at its widest point. Numerous lakes occur on the island and streams flow from these lakes into Lake Superior. We did not fish, but reports from others say the fishing is good. Our Skipper, Barry McKay, caught a fine mess of brook trout for our supper one evening. To hungry rockhounds they were delicious!

The topography is rugged. The shore is rocky and in some places steep cliffs rise from the water's edge. Rocky shoals near the shore are common, especially along the western south shore. In fact the entrance to Quebec Harbor on the south side of the island is marked by buoys for a narrow entrance-way between submerged rocks, although the entrance appears wide and clear on the surface. At two places along the island sandy beaches provide good landing for small boats (a small boat is necessary for going ashore, and if the water is rough caution is required among the shoal rocks). The interior of the island is dominated by high ridges and there are a large number of small lakes on the island. Channel Lake, about a mile from the light-house, is three miles long and nearly a mile across. The highest point is on the northwestern part of the island, near Quebec Mine.

The island is the easternmost extensive exposure of the Keweenaw formation and consists of a series of eruptive flows. Pitchstone (black rhyolite) is common along the eastern south shore. Much of the rock is amygdaloidal and contains agate, zeolite and calcite amygdules. Copper has been

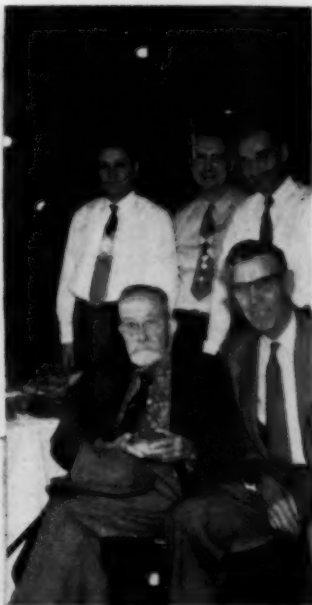
mined at the Quebec Mine. Native silver has been reported. Large veins filled with calcite and agate were seen.

Four of us have visited the island twice—Art Anderson, Paul Sandell, Cedric Erickson and Art Hedlund, all members of The Minnesota Mineral Club. We heard of large agates "as big as your head" from Hazen Perry, who in turn had received that information from Dr. L. O. Dart, of Minneapolis. Being ardent agate hunters, we were keenly interested. Information on how to get to the island was obtained after extensive correspondence with Canadian sources. The only practical means of going to the island at present is by boat. By road the nearest point is eighty miles south. Eventually Canadian highway No. 17 will be completed around Lake Superior and the nearest point then by road will be about ten miles. We arranged with Barry McKay at Sault Ste. Marie, Ontario, to take us in his good ship "Captain Dan."

On our first trip we left Minneapolis on June 2, 1954, and drove to Montreal River. The next morning we boarded the "Captain Dan" and left for Michipicoten Island. It was a rough and lusty Lake Superior that welcomed us, or attempted to overwhelm us. But the "Captain Dan" is a sturdy boat and Barry McKay is a skillful navigator. After eight and one-half hours of bouncing about we reached Quebec Harbor and calm waters. We tried to cook breakfast and lunch while under way. Cooking utensils would not stay put on the gas plate. Hedlund, who did the cooking, really had a hard time of it but finally did manage coffee. No elaborate meals were served you may be sure. But then hearty appetites did not generally prevail during the first voyage. Cedric, though, could eat anytime. He asked for more!

Early the next morning we started out for our agate hunt. First to the Quebec Mine.

This mine has a rather interesting history. It was opened in 1865 and again for a brief period in 1885. By following a trail blazed by some previous visiting geologists, we

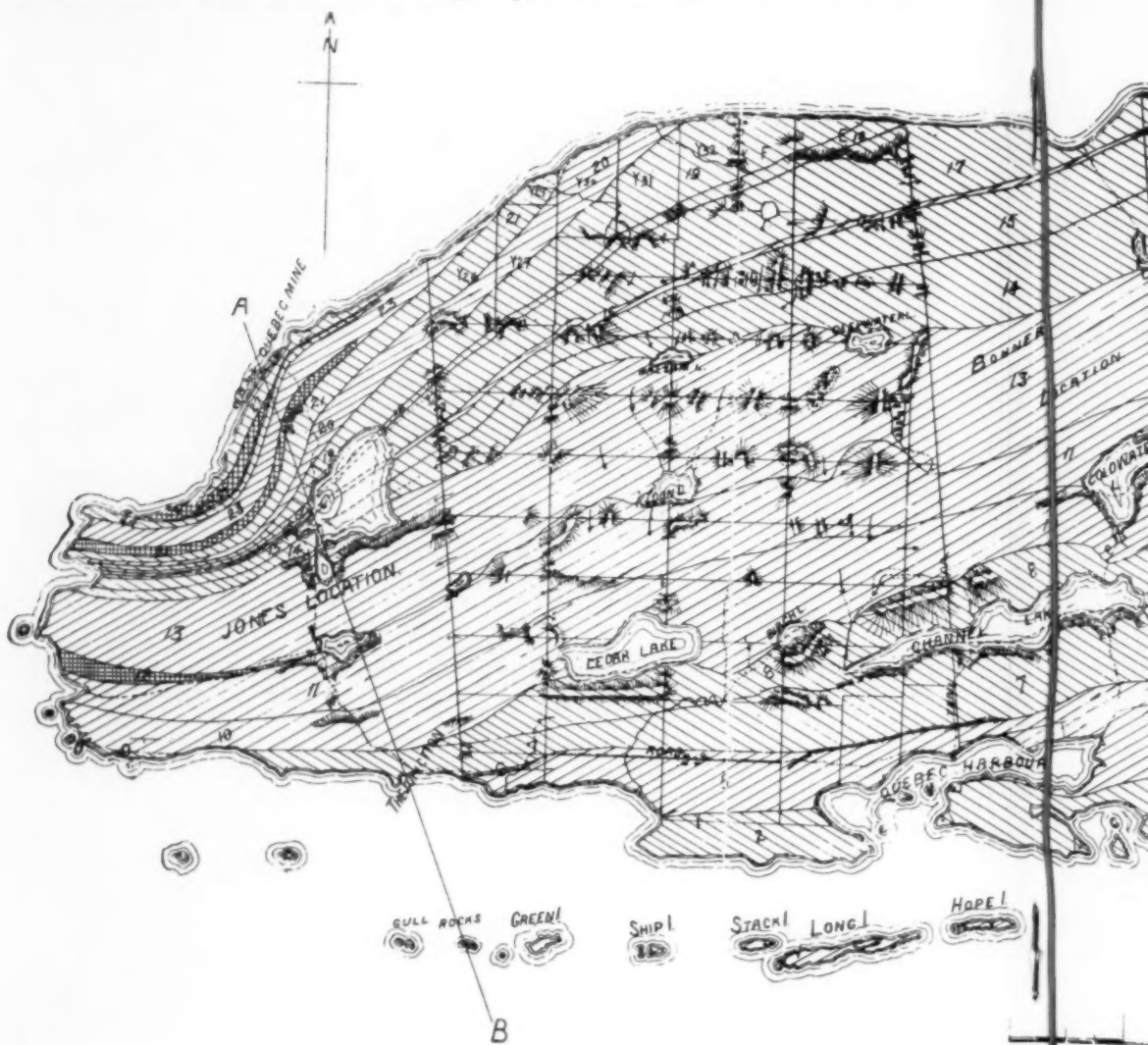


*Upper left*—THE "CAPTAIN DAN" AT ANCHOR IN COZENS' HARBOR; *center*—PAUL SANDELL POUNDING AGATE OUT OF AN OUTCROPPING OF PITCHSTONE; *below*—LOOKING OUT TO SEA FROM COZENS' HARBOR, SHOWING PITCHSTONE ROCK FORMATION AT RIGHT.

*Upper right*—*left to right, seated*, DR. DART, MR. ANDERSON; *standing*, MESSRS. SANDELL, ERICKSON AND HEDLUND; *below*, ART HEDLUND WITH 100 LB. QUARTZ AGATE.

found the mine. Not much there but a tumbled down wheel house and some old rusted machinery. The mine dump had trees a foot thick growing on it. The ore had been hauled from the mine to Quebec Harbor a distance of about five miles, following

carts. We found a couple of old abandoned carts and the place where a house and a blacksmith shop had been, but both had burned down. A number of old well-made cross-rail fences still in remarkably good repair were in evidence after several dec-



(Map from "The Geology of Michipicoten Island," a Thesis, by Dr. Ronald

a road close to the shore. We saw traces of the road and at Quebec Harbor we saw remnants of the old dock. The miners had used horses for hauling the ore in high wheeled

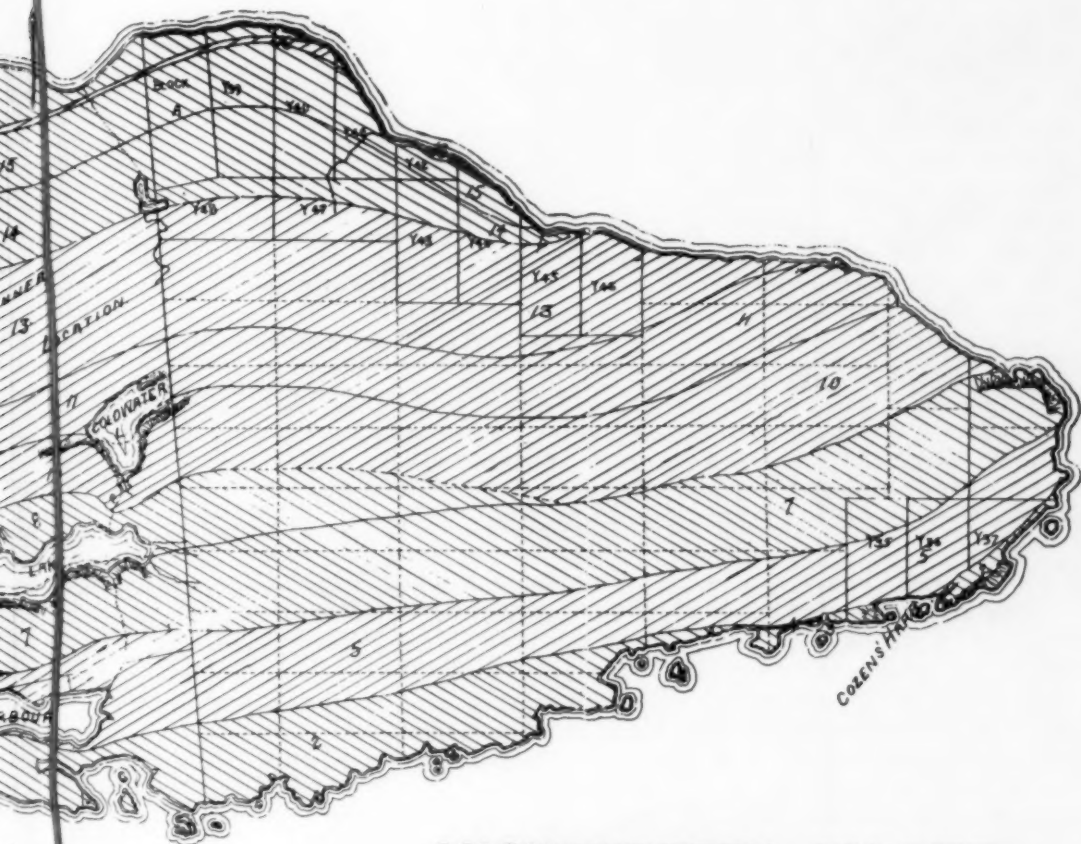
ades. A cave in the bluff back of the house-site had been used for storing blasting powder. When the mine closed the horses were left and they had roamed the island for years







before they died. Since then the mine and the island have been left pretty much to the beavers and the gulls. A Canadian couple tend the light-house on the island during the shipping season.

We spent some time exploring the mine

where, after finding a few scattered specimens, we found the spot. Huge agate nodules imbedded in a hard rhyolite matrix, and agate in veins. But the day was well spent and we had to give up on the large agate amygdules and the vein agate, and



## MICHIPICOTEN ISLAND.

-  *BASIC ERUPTIVES (FLOWS)*
-  *ACID ERUPTIVES. "*
-  *SANDSTONES AND CONGLOMERATES.*
-  *PYROCLASTIC*

THREE MILES

Map by Dr. Ronald A. Burwash, Toronto, Canada. Published 1905.)

site but found no agates or zeolites. Then we started working the gravel beaches along the west end of the island. We did not find agates until we reached the south shore

pick up the weathered-out agate on the beach. Having chartered our boat for only three days, we had to give up further explorations and return to Montreal River on

the third day. It was a rough trip and a tough day on the island. But it was great fun and we were bound to return.

All next winter we talked about it and by spring 1955 we had arranged for another trip. This time we chartered the "Captain Dan" for five days, which gave us three full days on the island. We started our exploration in the basic exposures along the south shore of the island. We found some weathered-out agate on the east end of the island, and on a small islet found some good vein agate. West of there to Cozen's Harbor mostly vein calcite was found with some agate in veins. On Agate Island, within Quebec Harbor, we found curious cone-shaped and cylindrical amygdules filled with agate, drusy quartz and calcite. A considerable number of solid beautiful "cone" agates were found.

As the year before, the best deposits of agate were found on the beach about three miles west of Quebec Harbor. Art Anderson and Paul Sandell found the best and largest "pan-cake" agates. Art Hedlund worked the veins with good success and Cedric prowled the gravel beaches and gathered numerous agates.

While hunting agates and other minerals was our main purpose, we nevertheless experienced many adventures not found in the usual rock hunts. For example, the second evening of our second trip the Skipper decided to anchor the ship on the lee side of a small island south east of Michipicoten itself. This little island had sheer cliff walls extending up some 25 to 30 feet from the water. We watched with open mouths as the Skipper scaled the cliff like a professional mountain climber and fastened the ship by means of heavy ropes from both the bow and stern to trees growing on top of the stone-cliffed isle. This was a precaution we took to protect the ship in case the night winds whipped up an unexpected storm.

Then on one occasion we pulled into a quiet bay or lagoon to eat lunch and Barry wanted to try some fly casting in a stream that ran into the lake at this point. Before Barry could make it to shore in the out-

board we spotted two beaver swimming in the clear calm waters. Beaver are peculiar critters, in that they will stay in the water instead of trying to hide or escape on shore. Apparently, beaver travel quite slowly on land. The fact is that the water was so calm and clear, we could see the lake bottom for an estimated depth of forty or fifty feet. Barry chased the beaver with the small punt. With Barry's wizardry in using the out-board motor for fast reverse, quick turns and sudden stops he finally had one beaver completely played out so that he was able to pick the beaver by the tail and hoist it into the boat. He then brought it into the cruiser. The beaver refused our offering of food and was just plain "skeered." After photographing the animal from all angles we gently lifted it overboard, again to see it dive down some twenty feet and finally head for shore to tell its mate of the terrible experience he had just encountered.

Speaking of pictures, Michipicoten and the adjoining small islands are a paradise for "shutter bugs." With the deep blue water as the foreground and the blue sky with white clouds as the background, we all shot pictures of the islands with their rough shorelines, high saw-tooth ridges inland and the caves and cliff formations showing up in relief against the green woods and forests.

There were also a great many smaller incidents that made for laughter, comradeship and a fuller appreciation of the magnificent outdoors. There was Cedric and the red paint, Paul who decided to feed the gulls, Art Anderson swatting mosquitoes in the dead of night in the upper bunk, and Art Hedlund doing the best juggling act you ever saw with a hot frying pan in one hand and a temperamental coffee pot in the other, on a rolling and pitching ship. Then there was the flabbergasted expression on Skipper McKay's face when we first approached him on the idea of hunting for rocks on the island instead of Lake Superior fish. He just shook his head, blinked his eyes and said: "You fellows really must be rocky."

However, our good friend Barry is gradually becoming a dyed-in-wool rockhound, as attested by the fact that he hunted and found agates with us each day of both trips and last winter he took an elective subject of geology at the University in London, Ontario.

In conclusion there is one more observation. In contrast to our first rough island crossing, on our second trip we had unbe-

lievably fine weather. Lake Superior can be well behaved. The only irritation was caused by little black flies that persistently attacked us. They can bite and did with resultant swelling of ears and face, and oh so itchy. But fly bites heal and are soon forgotten. The memory of the pleasure and joy we had on our two trips to Michipicoten remains and will be with us as long as we live.

## Largest Pallasite Meteorite

THE PALLASITE METEORITE (meaning space wanderer) now on display in the "Celestial Museum" at the Big Well in Greensburg, Kansas, is said to be the largest one of its kind so far discovered. Of the thousands of meteoric fragments found in all history, only a very small percentage is of this peculiar type, half iron and half stone.

(For story of the Big Well, see EARTH SCIENCE, November-December, 1955.)

This "Space Wanderer" was found in January, 1949, by Mr. H. O. Stockwell of Hutchinson, Kansas, on the farm of Mr. Ellis Peck, east of Greensburg, with the aid of a magnetic rake, a device which in its operation is similar to a mine detector.

Meteorites are small fragments of larger masses which have probably traveled many thousands of light years before coming in contact with the Earth. When they enter our atmosphere, traveling as they do at terrific speed, friction with the air soon causes them to become incandescent, and they are known as "meteors" or "shooting stars."

Comparatively few of them ever reach the Earth's surface, since most of them are consumed by the intense heat which envelops them in the upper atmosphere. Larger pieces, however, do survive and fall to the ground, and are then known as "meteorites," the suffix "ite" meaning "mineral substance."

When one sees and handles a meteorite, he cannot help being impressed by the awesome fact that he is touching a celestial

body, once a fragment of one of the stars of the heavens, or perhaps some broken up planet, of an age staggering our imagination and from an unknown distance of unbelievable magnitude.

Following is legend accompanying the meteorite on exhibit (see front cover of this issue):

### PALLASITE METEORITE Another World's Largest

Although no two falls have ever been found that are exactly alike, meteorites are roughly divided into general types—stone, iron, and stony-iron. This is a stony-iron of a most rare group known as Pallasites, and the largest known when found. It weighs 1,000 lbs. and was found in January of 1949 by Mr. H. O. Stockwell of Hutchinson, Kansas, under 63 inches of soil on what is now the E. Peck farm, six miles east and one mile south of this spot. Using electrical instruments of his own design but similar to the mine detectors of World War II, Mr. Stockwell also found the second largest (740 lbs.) of this type on the same farm in September, 1947.

The finding of a stony meteorite which has not been seen to fall is considered one of the rarest events in meteorites, but so many have been recovered from this one area that it has become known in the texts of both astronomy and geology as the "Meteorite Farm." The first cattle men noticed and wondered about them, and the Indians had a legend about their fall, but it was not until it was homesteaded by young Frank and Eliza Kimberly in 1885 that anyone knew what they really were. Ranging in size from no larger than a peanut to this specimen, but averaging about 300 pounds, a total of some 7,000 pounds have been recovered from this area of about two square miles.

### RECOMMENDED READING

"Ruby," Anonymous, December issue of *The Trilobite*. This brief article outlines simple tests for determining whether rubies are natural, synthetic or imitation.

## The Mineral Collector

by JOHN F. MIHELIC

THIS TERM OF "MINERAL COLLECTOR" applies to practically everyone in the Midwest Federation, for the gems, fossils and artifacts are minerals. Furthermore, I have yet to see a collector who did not have in his collection evidence of an interest in gem minerals in the raw: trilobites that ranged from almost pure calcium carbonate to the carbonized or the glamorous pyritized beauties; or a humble arrow point of real or doubtful vintage. However, the one who specializes, is the one who is the best informed on the particular bent that is followed.

To the gem cutter, crystallization, cleavage and hardness mean a great deal—unless he happens to be the slap-happy type who polishes but never produces a gem. There is plenty justification for doing just that, too—for in our hobby, no one is to decide just how much any one needs to know. We realize, of course, that the best informed person is the one who works toward the finest gem and is the one most likely to produce it. But then life is full of surprises to the experimenter.

Just what does a mineral collector look for, and where? The first question is one of those "depends on" things. Depends on how much room is available. That will limit the size. The wife, husband, or parents are more of a deciding factor than seems apparent. Do not make the mistake of overlooking the financial end. As for the "where" business, even a sand dune has possibilities.

Let us assume that an entire room is available for a display of the choice material. In that case, specimens up to 20 pounds and down to vial sized pieces cover the range. There is no problem except arrangement and cost. If the space available is a corner in the basement, the size becomes—or should become—critical. Chests of drawers, stationery filing cabinets, etc., aid greatly. The 2x3 size would seem to be a logical goal. The apartment dweller may have room for a single case—but the field of thumbnail

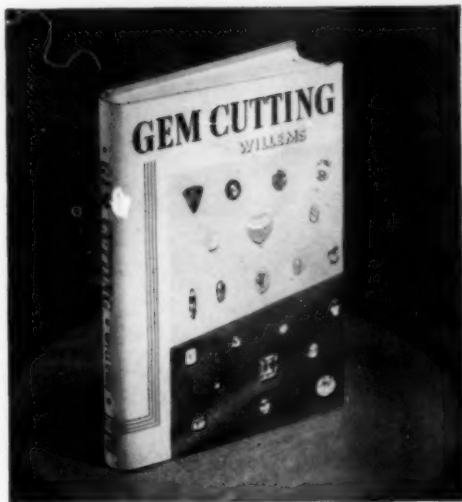


JOHN F. MIHELIC

sizes and micromounts affords opportunities to excel in possessing a wide variety of minerals, 300 vials take up next to no space.

That question of "where?". Why not start with the information that every state has available through the work of its geological survey. Get the publications, for the cost is nominal. Get the magazines in our field. Get in touch with and join the other enthusiasts in the numerous societies and read their bulletins, join in the activities. Rub shoulders with the doers—and be tolerant with those who go for the ride. Then don't forget that the mineral dealer is more apt to have better access to better specimens than you can hope to have. In any case, treat every excavation with suspicion—a crystal may be lurking there.

What you do beforehand is important, to make sure that, if you find a nice mineral secured to a rock wall, you can return home with it in a condition to be known as a specimen. You will need the tools necessary to extract it intact and to preserve it undamaged in some packing. Do not overlook a



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By J. Daniel Willems

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notebook containing a waxed paper packet of adhesive tape numerals. (You can stick a number on to the specimen and write the same number into your notebook with whatever data seems appropriate.) As to the tools, a good quality prospector's pick, a heavy hammer, a few chisels of varying length and thickness—one thin one, and a pry bar will make up a kit that will enable you to work out the beauty without marring it. In loose material, a short shovel is invaluable. The newspaper packing, that most collectors use, provides a cushion to break the fall of the specimen as well as a protection wrap as it is being carried.

One obstacle to the appearance, as well as to the weight, is the excess of matrix that makes up the bulk of the piece you have extracted. Don't make the welkin ring with hammer blows. Rather cushion the piece and carefully use the chisel—preferably from the back. Try a couple cautious chips till you see how it trims, then use more vigorous means if it seems the thing to do. Above all else, avoid the ugly duckling bruises, that send many a promising piece to the rock garden.

If clay adheres to the specimen, scrape most of it off. If it covers crystal tips, let it stay until you can work on it at home. Rain is one of the best clay removers that I know of, and we frequently let rainfall do our final cleaning. If the crystals are calcite, selenite or some other easily scraped material, we are apt to cut bamboo scrapers, for they do not soften in water and are firm enough to cut away the mud. Detergent cleaners break up clay and other sticky muds and rinse very well.

Your specimen is worth much more if it is catalogued. Many museum curators consider the location and time as of first importance. They verify your identification and in some cases have corrected the identification of a specimen 100 years after its extraction. We like to use 4x6 cards with numbers corresponding to that on the specimen. Lacquering the number on the specimen insures its preservation. Use the system of numbering that corresponds to what you

emphasize in your collection.

Naturally, a nice specimen craves a prominent display. Why not satisfy that yearning and get some nice clean cases—or build them. Even shelves will do. If a specimen is worth taking home, it is worth caring for.

These are but a few ideas that we have followed after evaluating many other methods. If they serve as a starting point for you to reject or adopt, I have fulfilled my duty in presenting an overall picture of mineral collecting.

## Midwest Club News

BERNICE WIENRANK, *Club Editor*

4717 North Winthrop Avenue  
Chicago 40, Illinois

CHICAGO ROCKS AND MINERALS SOCIETY was addressed on December 10 by Professor Arthur Blocher, a noted mineral collector. Professor Blocher spoke on "Our Experiences Collecting Dugway Geodes."

At the close of the program, Santa arrived and presented each member with a mineral or lapidary gift from a "bejeweled tumbling barrel."

WISCONSIN GEOLOGICAL SOCIETY listened with rapt attention when, on October 10, Robert Haach, gemmologist, told the group about his trip into the Brazilian jungles in search of diamonds. The expedition endured many hardships, for the rain forests of South America are hot and humid and teem with insects, including army ants. Their rivers are infested with the dread carnivorous piraya fish. Deep in the jungles, the group found diamonds and secured mining claims. Mr. Haach illustrated his talk with colored photographs and both cut and uncut diamonds from his mine.

EVANSVILLE LAPIDARY SOCIETY at its September meeting heard Keith Hodson speak on "Opal Mining." On display was Mr. Hodson's prize opal find, the Hodson Rainbow. This magnificent opal is ten inches long and five inches wide. It well deserves its name, for it flashes with all of the colors of the rainbow.

MINERALORISTS OF JOLIET at their November meeting heard Dr. Ben Hur Wilson speak on "Unusual Forms of Quartz." From his extensive collection, Dr. Wilson selected fine specimens of quartz to illustrate his lecture.

CEDAR VALLEY ROCKS AND MINERALS SOCIETY'S display of gems and minerals was the stellar attraction of the Cedar Valley PTA Science Show, which was held in Cedar Rapids, October 22-23. Many visitors asked to be notified of the club's next meeting.



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CVR&MS has presented the Coe College Library and the Public Library of Cedar Rapids with subscriptions to EARTH SCIENCE. This is an excellent way to promote popular interest in the earth sciences.

MICHIGAN MINERALOGICAL SOCIETY on December 12 viewed some fine color slides of minerals in the British Museum of Natural History. The slides were made by member Jerry Wehlann from handsome cards obtained from the museum.

MARQUETTE GEOLOGISTS ASSOCIATION was host to a combined meeting of the Chicago area clubs on December 3. William Bingham, president of the Midwest Federation, gave the groups an informative lecture on "Lapidary Short Cuts," and discussed the Minnesota Mineral Club's plans for the 1956 Convention of the American Federation, which will be held in the Twin Cities (St. Paul and Minneapolis), July 12-15.

ROCHESTER EARTH SCIENCE CLUB at its November meeting heard Dr. Frank L. Fleener of Joliet, Illinois, speak on "Silver—The Queen of Metals." Dr. Fleener selected this topic because the club is inaugurating a class in jewelry-making for the winter months.

INDIANA GEOLOGY AND GEM SOCIETY won second prize for its exhibit of gems, crystals and colorful minerals at the Indiana Hobby Show, which was held in Indianapolis, November 12-20. This was the club's first public display.

EARTH SCIENCE CLUB OF NORTHERN ILLINOIS on December 9 heard Dr. Joseph Free give a lecture on "Digging Down to Dothan." Dothan is the ancient city, 60 miles north of Jerusalem, where Joseph was sold into slavery by his brothers. Dr. Free and his staff spent several seasons excavating Dothan and uncovered evidence that a great civilization flourished there even before the time of Abraham. The talk was illustrated with colored motion pictures of the excavating done during the 1955 season and with objects taken from the dig, which date back 3,000 to 5,000 years ago.

NEBRASKA MINERAL AND GEM CLUB was host to the CENTRAL IOWA MINERAL AND GEM SOCIETY on October 9, when the clubs made a field trip to the Queen Hill quarry near Omaha, Nebraska. They found an abundance of horn coral fossils and some lovely pyrite octahedrons in quarry.

CENTRAL ILLINOIS ROCKHOUNDS on December 4 heard Mr. S. E. Farin talk on "Identification of Rocks." Afterwards, Mr. Farin presented each member with a mineral identification chart and some specimens to identify.

THE MIDWEST FEDERATION EXCHANGE, managed by Frank Sadilek, provides members of the Midwest Federation with an opportunity to trade fossils, minerals, crystals, gems, etc., with each other.

The Exchange list, begun in 1950, now numbers about 200 and is still growing. The list is published periodically with a bulletin aptly entitled "Trade-Wins." The bulletin, which is edited by Mr. Sadilek, contains many fine articles, "thumb nail" personality sketches and news about members of the Exchange.

For full details and an application blank, write Frank J. Sadilek, 1308 West 42nd St., Des Moines 11, Iowa. Enclose a stamp to cover postage.

#### OTHER SOCIETIES

SAN ANTONIO ROCK & LAPIDARY SOCIETY held its annual Gem and Mineral Show, October 29-30. Competitive exhibits featured cabochons, spheres, faceted stones, lapidary novelties and mineral collections. There were also non-competitive working-exhibits of gem-cutting, tumbling, sphere-making, and jewelry-making. Nearly 5,000 people, representing 30 states and 3 foreign countries, visited the show.

WICHITA GEM AND MINERAL SOCIETY on November 27 viewed "Beauties of the Mineral World," 50 transparencies of fine and colorful mineral specimens. The slides, which were projected and commented on by Nora Lee Dennett, included the various coppers, wire silvers, wire gold, botryoidal turquoise, chrysoberyl and cinabar.

OKLAHOMA MINERAL AND GEM SOCIETY at its October meeting was shown "Beauty in Metals," a film illustrating ring-making.

The club planned to advertise its annual gem and mineral show by parading a donkey down the main street of Oklahoma City, wearing this sign: "Everyone but me is going to the Gem & Mineral Show at the V.F.W. Hut, 1103 N. Blackwelder, on Sunday afternoon, October 23."

COMPTON GEM AND MINERAL CLUB on November 3 heard Mrs. Jessie Hardman, secretary of the California Federation, speak on "The History and Romance of Silver." Mrs. Hardman displayed beautiful examples of silver work from her own collection.

SAN DIEGO LAPIDARY SOCIETY's president, Charles Tucker, has turned his rock shop over to the society for a lapidary shop. It is completely furnished with lapidary, faceting and silver work equipment.

MINERALOGICAL SOCIETY OF ARIZONA is sponsoring a Girl Scout troupe, to help its members earn their mineralogy badges. Sponsoring Scout groups is a very worthwhile project for earth science clubs, for in doing so they are fostering the scientists of tomorrow.

MIAMI MINERAL AND GEM SOCIETY on September 12 was shown the colored motion picture, "In the Beginning," which deals with the early geological history of the earth. The display for the evening was a collection of Florida's agatized coral, both in the rough and polished.



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# THE PRODUCTION OF FLAT SURFACES

by LLOYD H. SPRINKLE

IN DISCUSSING the production of flat surfaces one sometimes has the feeling that there are so few who are really interested in this subject, that it may perhaps sound a bit prosaic. Possibly you will say, "who cares about flat surfaces, anyway? Nature's lines of beauty are curves."

How very true. The involute whorl of a seashell, the sweep of a bough against the sky, the swelling beauty of a rosebud, a billowing sail against the horizon, a baby's cheek. All lovely, all curves. And so you say, "I'll stick to my cabachons on small pieces and I'll use generous curves on the bounding surfaces of larger specimens."

And yet Nature gives her blessing to flat surfaces and straight lines. The perfection of edge and surface on a perfect crystal of fluorite, the facets of a Herkimer diamond, those rare and lovely sunrises and sunsets whose chief beauty is the fan of sun rays projected through clouds, the perfect mirror of a small lake on a windless evening, the almost frictionless perfection of that same surface as you take your first strokes across it after a hard night's freeze. All flat, all lovely.

So let's consider for a moment the places where flat surfaces will benefit the rockhound who has the urge to do a little grinding and polishing. The first application, and one we will skip, is the faceting of gem stones. I don't believe anyone will question the need of 57 flat surfaces on a brilliant cut diamond or ruby. Sometimes a flat surface in a larger setting, a pendant or brooch, is as effective as a cab, and has the merit of variety. But I believe the major place for flats is in the specimen cabinet or transparency case.

This immediately poses the problem of size. It is one thing to produce an apparently flat surface involving one quarter of a square inch and quite another to grind and polish flat, an area 4 inches by 5 inches or 20 square inches in all. And if that area is full of shallow dips and minute hills, to a true craftsman it becomes an abomination instead of a thing of beauty. The same holds true of spherical surfaces. I speak of a true sphere. And so, because to the most casual examination a plane or sphere reveals its flaws, it is necessary that we have very definite tools and techniques to produce those surfaces.

Perhaps one of the charms of the elliptical cabachon is its freedom from rigid geometrical boundaries. It may be slender or plump, high or low, depending on the whims of free hand grinding, the only *must* being that varying curves must blend smoothly into each other. Hence the equipment is simple: grinding wheel, belt, drum, or disc sander, a flexible polisher, either felt or leather, a true eye and a steady hand.

Numerous good magazine articles have taught everyone how to cut spheres. If you want to make cabs which are true segments of spheres, then you must borrow from the methods of the optical worker, for he devotes his lifetime to generating not spheres, but spherical surfaces on lenses. It cannot be done free hand, but requires

a tool which is a true section of a sphere, and of course a different tool for each size cab.

But let's get to the tools and methods used to produce a flat surface. If you have unlimited funds you may do as the big optical companies do. Put your work on a Blanchard grinder using diamond charged segments on the wheel and your specimens will be truly flat and ready for polishing in about three minutes. Most of us must be content with more modest equipment, and much of it can be made. First we need a turntable spinning horizontally on a vertical shaft. Around this we need a splash pan of generous size with a drain plug in the bottom.

And now the grinding tool. Not a carborundum wheel this time. It would not stay flat. Instead a steel or cast iron disk at least 12" in diameter, 14" is much better. Have it ground flat both sides at any tool shop that does Blanchard grinding. It should be at least 3/4" thick both for rigidity and weight.

For flat grinding we will use loose grain abrasive of progressively smaller grit sizes. There will be no sanding on belt or disc. Spindle speed is limited by centrifugal force acting on the abrasive and water. My own spindle runs at 90 rpm, which is near the limit for a 14" disk. I use grain sizes starting with #80 and progressing to 120, 220, 320, 400, 500, 600, and 900, skipping some sizes on soft materials, but using all grades on agate. Now, to work. Place your metal disc on the turntable, centering it very carefully. Sprinkle on a teaspoonful of #80 and a little water. Take a few strokes across the disc with your specimen to spread the abrasive, and start your machine. Continue to grind with #80, adding more grit and water as necessary, until every saw mark and surface unevenness has been removed. Now wash up, scrupulously, with a brush, the tool, while it is running. The specimen, in a pail of water, and then under the faucet. Very rough edges and porous areas require extra attention to get rid of every clinging grain. Now comes your 120 grind, clean up, your 220, and so on. The same practise prevails here as in optical work. Grind out the pits of each previous grade with the size you are using. A good strong light and a magnifying glass are essential here. Don't worry about the center but look for pits at the edge of the work. When the last stage of fine grinding is completed, wash up thoroughly, lift the grinding tool from the turntable and replace it with the polishing lap.

This polishing lap will probably offer more difficulties than all the other items. I'll tell you how to make it, and if you forget go to the library and get a book on Amateur Telescope Making and read up on pitch laps. You see I am not going to recommend felt. In fact, I condemn it wholeheartedly for most work. You need another metal disk, although this one need not be as flat as the grinding tool. But flat enough to lie steady on the turntable. You need a few pounds of coal tar pitch, melting

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point about 170°. Be sure it is coal tar, not crude oil residue or asphalt. At room temperature it should be hard enough that 5 seconds' pressure of the thumb nail is needed to make a definite impression. If too hard, a teaspoonful of turpentine thoroughly stirred in will make a real change in 3 lbs. of pitch. To prepare your lap, level your metal plate, put a heavy paper band around the edge, projecting up 1/4" to 5/16" to retain the pitch. Melt your pitch slowly in an old coffee can and keep a lid handy to slap on it if it should catch fire. It's never happened to me in 20 years, but it is possible. Stirring will speed the melting process but when the last lump has melted, your pitch will be much too hot. Set it off the fire and let it cool until it pours like molasses. Pour it on your metal plate, which should be previously warmed above blood temperature, and let it cool. After a couple of hours score it lightly with a knife, remove the paper collar, center it on the turntable, apply a little cerium oxide mixed to skim milk consistency, and start polishing. A word of caution. "If a little is good, more is better," does not apply here. A thick cream may be OK on felt but on pitch it becomes a million roller bearings, and you never get a polish. Keep your mixture thin.

All this is based on the premise that you will hold your specimens in your hands, turning them and applying pressure as necessary. Please don't think that I am saying this is the only method. If you like machine work perhaps you may want to build a grinding and polishing machine with a power driven arm to oscillate and rotate the specimens. Another variation is the cementing of small tiles such as are used in mosaic floors to a metal plate to be used as a grinding tool. I personally switch from a metal to a glass grinding plate at the 500 grit size, and do all my fine grinding on glass. This cuts down the danger of scratches. You may prefer rouge or Barnesite instead of cerium oxide. Rouge is much cheaper but slower. It gives the finest polish you can obtain. I do not recommend tin oxide. It may do with felt for cabs, but it is hopeless on pitch.

And here is more reason for fear and trembling. Felt is terrible or worse if you want flat surfaces that are flat. In the glass industry it is used to polish plate glass, which is not flat. In the optical business it is only used for the cheapest grades of optics. Never for precision work. I have seen fine annealed boro silicate crown lenses come off a felt polishing lap with surfaces that looked exactly like lemon or orange rind. In fact, such surfaces are known in the trade as lemon peel. And that was caused on a thoroughly homogenous material by the springiness of the wool fibers in the felt. You can imagine what happens on materials of varying hardness in the same slab. Pitch has flow characteristics but no springiness, hence does not undercut. That is why I find it the only possible medium for polishing fossil corals for microscopic study.

Another application of flat working is one which our good friend Will Beresford uses. He has made many slides for projection on the screen by cross sectioning rock or mineral specimens and working them to requisite thinness. Some

materials can be slabbed thin enough on an exceptionally true running thin diamond saw, but specimens of complex structure and dense color must be as thin as 2 mm. or less. This requires cementing them on a runner and grinding them to the necessary thinness. Mr. Beresford finds some project best on the screen if only fine ground, some should be polished, but that they all need to be handled like egg shells in cementing and uncementing.

In conclusion, as evidence that the simple tools I have described make possible the production of flat surfaces, consider two fused quartz discs. I produced them. They were ground on cast iron and glass, polished on pitch with cerium oxide, and the final work was done with rouge. Each is flat across a 2" surface within one millionth of an inch. These are the testing tools of companies that make Johansson Gage Blocks or Jo-Blocks. Used to test the flatness of faces that may be wrung together and will not pull apart. These are optical flats. Certainly none of us is going to such extremes on rocks, but it is good to know what the equipment you use is capable of doing.

#### ADDENDUM

In grinding: Wash the specimen in a pail of water first, before taking it under the faucet, because silicon carbide is heavy and will clog the drains.

Coal tar pitch: Is usually sold by the ton. Is quite inexpensive. Small amounts can probably be obtained from any roofing company that lays flat roofs on commercial buildings. To those rockhounds in isolated areas who can't find a source, the Barrett Division of Allied Chemical and Dye Corporation produces coal tar pitch and probably would tell you from whom it can be obtained.

Turpentine: Is a fairly good solvent for pitch. Standard practice to insure pitch sticking to polished surfaces is to wipe the surface with a cloth moistened with turpentine before pouring the melted pitch.

Xylol (Xylene): The best solvent for cleaning pitch from finished specimens. Sometimes a little pitch will be forced into porosities in a slab while polishing. Very cold pitch is as brittle as glass, and may be readily chipped off, but a slight stain may remain and xylol or turpentine will remove it.

Flatness of lap surface: Hot pitch will level itself as any other liquid will. If it gets cold and stiff before it has flattened out, warm the metal plate from below, or warm the pitch surface with an infrared lamp from above. Be patient. Pitch flows slowly. Once flattened use a straight edge and a sharp pointed tool and score the surface in two directions, 90 degrees apart. Score 1/4 inch deep, 1/4 to 1/2 inch spacing. These grooves will slowly close up with use. Recut as necessary. They distribute the polishing compound.

GARNET is the accepted birthstone for January throughout the world and is the gem of Aquarius, (the water carrier), January 20th to February 19th. ("Birthstones" continued on page 30.)

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The Guardian Angel for January is Gabriel, whose talismanic gem is the Onyx.

The special Apostle is Simon Peter.

The flower is the Snowdrop or the Primrose. Lucky charms ascribed to this month are the Lincoln Imp, Elephant, Ass, Pig, Tortoise, Mummy, and Case and Skull.

The Almandine Garnet has an ancient history and was worn in the Far East to ensure health and happiness, power, grace and victory, and is also said to reconcile differences between friends. It is very reasonable in price, and in colour often approaches the Ruby in richness, but there is a rare and expensive variety known as the Demantoid Garnet, which is brilliant green in colour, almost surpassing the Diamond in brilliance.

Another unusual variety known as the Grosular Garnet is sometimes very similar to Jade in appearance and sold as "African" Jade.

Symbolic of Love, one of the famous Garnets in history was a fine specimen which Pope Innocent III gave to Richard Coeur de Lion, and in the age of chivalry, Knights gave Garnets to their ladies in pledge of constancy.

The Onyx, which is the talismanic gem of Gabriel, is a very cheap stone in comparison but takes a very high polish. It is usually black with a layer of white either across the stone or encircling it, or even spread completely over the top surface.

AMETHYST is the accepted birthstone for February throughout the world and is the gem of Pisces, (the fishes), February 20th to March 20th.

The Guardian Angel for February is Barchiel, whose talismanic gem is Jasper.

The Special Apostle is Andrew.

The flower is the Primrose or Violet.

Lucky charms ascribed to this month are the Skull, Pig, Fish, Coins, Horseshoe, Ivy Leaf, Donkey, Elephant, Lincoln Imp and Frog.

The Amethyst has been used from very ancient times and is one of the most beautiful and yet inexpensive of precious stones. In early times it was in great demand by heavy drinkers, owing to the belief that to wear an Amethyst would prevent drunkenness despite overindulgence.

The name itself comes from the Greek, meaning "Not Drunken," and there is a Greek myth telling of Bacchus falling in love with a beautiful nymph who did not return his affection. Instead, she fled to the protection of the bachelor goddess Diana, who changed her into a shining white crystal.

Bacchus, in an unusual spirit of penitence, poured his wine over the transformed maiden, turning the stone into the colour of the grape, and swore that henceforth all who wore it would be immune from the evils of intoxication. Pale Amethysts are very cheap compared with those of a rich purple colour, and they can be obtained in all shades of purple from almost colourless to nearly black.

Jasper, which is the talismanic gem of Barchiel, is an opaque, impure variety of Quartz, of a reddish Yellow, dark green or brown colour, not often used in jewellery, being rather uninteresting but cheap in price.

—KENNETH PARKINSON, F.G.A., Hull, England



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